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ONTARIO DEPARTMENT OF EDUCATION

CURRICULUM S-17A (1966)

PHYSICS

Senior Division Grade 11

Replacing the Physics course as printed in Curriculum S-17A, Physics.
For introduction in September, 1966.

1966

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PHYSICS

Grade 11

This new course of study for Grade 11 Physics is similar to the previous Curriculum S–17A with certain deletions. About four weeks course time have been removed to ensure that the time allotment is realistic. Certain topics have been deleted because they were difficult to integrate with the rest of the course, tended to break its continuity or had been covered in earlier grades. This course of study should be carefully examined so that time is not wasted on topics that have been omitted. Furthermore, it is suggested that conversion of units between the British and Metric Systems be avoided throughout the course. The final unit of the course, TOPICS IN MODERN PHYSICS, has not been expanded in content, but a more adequate description of the original content is given.

The suggested time allotment is an indication of the comparative depth of treatment to be given each unit. The teacher is strongly urged to watch the suggested time allotment, since it is essential that all units be fully covered. Teachers are encouraged to amplify and extend the study of individual items as time permits. The teacher is free to determine the order in which the various units will be studied, although he will probably prefer to begin the year's work with Unit One, and to conclude it with Unit Four.

The ultimate aim of the course is adequate understanding of the concepts and principles involved. This aim is best served if the experimental approach is emphasized.

Pupil records should include well-labelled diagrams: observations and conclusions must be expressed in clear, concise English.

Pupils should be taught to support generalizations by applications which may be found in abundance in the world about them.

TIME ALLOTMENT

Unit I	**MECHANICS (5 weeks)**	
	1. Measurements	½ week
	2. Motion and Force	3½ weeks
	3. Work, Energy and Power	1 week
Unit II	**VIBRATIONS and WAVE MOTIONS (7 weeks)**	
	1. Wave Phenomena	2 weeks
	2. Sound	1½ weeks
	3. Light	3½ weeks
Unit III	**ELECTRICITY (9½ weeks)**	
	1. Electrostatics	1 week
	2. Current Electricity	4 weeks
	3. Electromagnetism	4½ weeks
Unit IV	**TOPICS in MODERN PHYSICS (6½ weeks)**	
	1. Electronics	3 weeks
	2. Atomic Structure	2 weeks
	3. Nuclear Physics	1 week
	4. Living in an Atomic Age	½ week

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Unit I

MECHANICS (5 weeks)

The measurement and analysis of changes in motion provide a foundation for the generalizations expressed in Newton's laws. The concepts of force, energy, and power are developed to give a fuller description of experience; and units are established for them in the M.K.S. system.

1. Measurements (½ week)

(a) Review of measurements as prescribed for Grade 9

(b) The three fundamental measurements: length, mass, and time

(c) Systems of measurement: British System (F.P.S.) and Metric System (M.K.S. and C.G.S.)
Conversions between the British and Metric Systems should be avoided.

(d) The accuracy of measurements. (No measured quantity is completely accurate: this topic is most appropriate in connection with the student's own experimental work.)

2. Motion and Force (3½ weeks)

(a) Explanation of motion, speed, velocity and acceleration – simple problems
Vectors and scalar quantities
All motion is relative – simple problems on relative velocities of moving objects
The formula $v = u + at$: simple problems

(b) Review examples of force (Grade 10) and extend the idea of force to include direction (vector quantity)
Review Newton's First Law of Motion
Inertia as a property of matter
Simple experiments to show inertia in both stationary and moving objects
Mass as a measure of inertia
Examples of inertia

(c) Examples of balanced and unbalanced forces acting on objects at rest and in motion
The relation of acceleration to force and mass
Newton's Second Law of Motion
The formula $F = ma$
The newton as an absolute unit of force
The advantage of using absolute rather than gravitational units of force
Simple problems

(d) Newton's Third Law of Motion
Examples

(e) Gravitational force as a property of all matter, the meaning of weight
The factors affecting gravitational force
Newton's Law of Universal Gravitation
The variation of weight with distance from the centre of the earth
The differences between mass and weight

3. Work, Energy, and Power (1 week)

(a) Review the meaning of work in mechanics
Definition of joule (newton-metre)

(b) The meaning of energy
Kinetic and potential energy
Heat as kinetic energy of molecules

(c) The conservation of energy
Study of a simple pendulum stressing that the sum of the kinetic and potential energy remains a constant (neglecting friction)

(d) Power: the watt and the kilowatt
Applications and simple problems

Unit II VIBRATIONS AND WAVE MOTIONS (7 weeks)

Energy transmission in waves is illustrated with coiled springs and ripple tanks. Interference phenomena, including standing waves, are demonstrated in mechanical, acoustical, and optical systems. Geometrical optics is examined by pupil experiments.

1. Wave Phenomena (2 weeks)

(a) Review vibrations and related terms

(b) The transmission of energy by transverse and longitudinal waves
Explanation of the transmission of energy from particle to particle

(c) The universal wave equation (velocity is equal to the product of frequency and wave-length)
Simple problems

(d) The concept of interference between waves (both transverse and longitudinal)
Illustrate by one or more mechanical demonstrations

2. Sound (1½ weeks)

(a) One or more experiments to illustrate interference, e.g.

(i) silent regions near a vibrating tuning fork,
(ii) production of beats,
(iii) silent regions near two loudspeakers connected to the same source

(b) Resonance

(i) Mechanical illustration of the principle of resonance
(ii) Experiment to demonstrate sympathetic vibrations by resonance
(iii) Experiment to demonstrate resonance in air columns of different lengths
Application in musical instruments

3. Light (3½ weeks)

(a) (i) A brief review of light transmission (Grade 10)
(ii) Review and extend the work on reflection to include experiments using a concave mirror
(iii) Review refraction and extend to include index of refraction
Critical angle and total internal reflection

(b) Lenses
  (i) Experiments to show the effect of (1) a convex lens (2) a concave lens on a beam of parallel rays
  (ii) Experimental study of images formed by a convex lens (both real and virtual images)
  (iii) Locating images by diagrams for convex and concave lenses

(c) Applications – a general understanding of two or three of the following:
  (i) the camera and the projector
  (ii) the normal eye and eye defects: corrective lenses
  (iii) simple and compound microscopes
  (iv) refractor telescopes, celestial and terrestrial
  (v) the prism binocular and the functions of the prisms

(d) A demonstration of Young's double slit experiment to show the interference and hence the wave nature of light

Unit III ELECTRICITY (9½ weeks)

Electrical units and circuits are examined in the light of the concept of energy. Opportunity is provided for pupils to gain experience with a variety of circuits, including combinations of resistors, and those involving electromagnetic interactions.

1. Electrostatics (1 week)

(a) Review of the concepts taught in Grade 10

(b) The electrical structure of solids and explanation of electrostatic effects

(c) Charging a conductor by induction
Explanation

2. Current Electricity (4 weeks)

(a) The transformation of mechanical, chemical and radiant energy into electrical energy

(b) Review of electrical circuits and their symbols

(c) Definitions of the following units:
  (i) one coulomb of charge is $6{\cdot}24 \times 10^{18}$ electrons
  (ii) one ampere of current is 1 coulomb per second
  (iii) one volt of potential difference is one joule per coulomb

(d) The transformation of electrical energy to heat energy
Experiment to determine the electrical energy equivalent of 1 calorie
Simple problems

(e) Experiment to determine the relation between the potential differences across the ends of a conductor and the current through it – Ohm's Law
Definition of 1 ohm resistance as 1 volt per ampere

(f) Factors affecting the resistance of a conductor

(g) Problems involving Ohm's Law, including examples with resistors in series and in parallel

(h) The power rating of electrical appliances
The kilowatt-hour as a unit of energy
Problems, including the cost of electrical energy

3. Electromagnetism (4½ weeks)

(a) Brief review of magnetism

(b) Demonstration of induced magnetism; discussion of permeability

(c) Review of the magnetic field about conductors where electrons are moving

(i) in a straight wire,
(ii) in a single loop,
(iii) in a helix or coil. The left hand rules

(d) Experiments to determine the relation between the strength of the magnetic field and

(i) the magnitude of the current,
(ii) the number of turns in the coil

(e) Experiment to show the effect of the permeability of the core material on the strength of the magnetic field

(f) Experiment to illustrate the motor principle

(g) The moving-coil galvanometer

(h) The use of the moving-coil assembly in ammeters and voltmeters
The structure, uses, and resistance qualities of good meters

(i) Electromagnetic induction: experiments to illustrate the production of a potential difference by moving a magnet near a conductor

(j) Factors determining the magnitude of the induced potential difference

(k) Experiment to illustrate the production of an induced current by opening and closing a primary circuit coupled with a secondary circuit

(l) Lenz's Law: the direction of the induced current (electron flow): the application of energy conservation to electro-magnetic induction

(m) The alternating current generator
The use of slip rings

(n) The two-segment commutator to convert an A.C. generator to a D.C. generator

(o) The simple D.C. motor

(p) Transformers
The structure and action of step-up and step-down transformers

(q) Uses of transformers
The distribution of electrical energy

Unit IV TOPICS IN MODERN PHYSICS (6½ weeks)

The work of previous units forms a basis for understanding experimental developments in electronics, atomic physics and nuclear energy. At the same time, these topics create the need for revisions in some aspects of classical physics. They should make pupils aware of recent issues in the development of physics and its influence on society.

1. Electronics (3 weeks)

(a) Conduction through gases:
discharge of electroscope by flame and electric spark
demonstration of conduction through air in a Crookes' tube as pressure is reduced

(b) Cathode rays:
demonstration of properties of cathode rays and identification of them as streams of electrons

(c) X-rays:
sources, properties, uses and precautions
contrast with cathode rays

(d) Photoelectricity:
the photoelectric effect (zinc plate experiment)
the phototube: construction and applications

(e) Thermionic emission:
the diode: construction, action, conditions for plate current (If possible, this should be done as a student experiment)

(f) Rectification:
half-wave rectification only; use a neon bulb to identify the input and output (If possible, this should be done as a student experiment)

(g) Amplification:
the triode: construction, effect of grid (If possible, this should be done as a student experiment)
demonstration of the triode as a simple voltage amplifier
calculation of the amplification factor
demonstration of a simple audio-amplifier

(h) Application of rectifiers and amplifiers:
transmission and reception, referring particularly to detection, amplification, and the principle of resonance

(i) Applications of the above principles in television:
the cathode ray tube used in the cathode ray oscilloscope and kinescope
the function of the television camera tube (conversion of light energy to electrical impulses)
the role of the photoelectric effect in the performance of this function
the function of the kinescope (conversion of electrical impulses to light energy)
block diagram of the television transmitting-receiving system

2. Atomic Structure (2 weeks)

(a) Charge/mass ratio for electrons (Thomson):
the factors affecting the amount of deflection of a charged particle passing through magnetic and electric fields
the method and apparatus used by J. J. Thomson in his research into the nature of cathode rays
the results of Thomson's research; charge/mass is constant for all cathode rays

(b) Charge on electrons (Millikan):
a brief discussion of the apparatus and method used by R. A. Millikan in the oil drop experiment to demonstrate the existence of the elementary charge and to determine its magnitude

(c) Radioactivity:
the discovery of radioactivity by Bacquerel
the nature and importance of the work of the Curies
types of radioactive emissions and their properties
the detection of radioactivity – photographic film, electroscope, Geiger counter and cloud chamber (Experimental work where possible)

(d) Concept of the nucleus (Rutherford's experiment):
the nature and importance of alpha particle scattering

(e) The Bohr concept of the hydrogen atom:
Bohr's concept of "allowed" electronic orbits
bright line spectra of atomic hydrogen

(f) Structure of the nucleus; atomic number; mass number; isotopes:
brief mention of the discovery of the neutron by Chadwick
symbol representation of nuclear structure, ${}_{Z}X^{A}$
the meaning of the term isotope

(g) Electron shell structure:
a study of the first 18 atoms to show the arrangement of the electrons in shells around the nucleus

3. Nuclear Physics (1 week)

(a) Simple nuclear reactions:
artificial transmutation of elements
equations of nuclear reactions
brief reference to particle accelerators

(b) Nuclear fission:
fission of the uranium atom by neutron bombardment
chain reaction: nature and importance
atomic bomb: uncontrolled nuclear fission
nuclear reactor: controlled nuclear fission
brief reference to control by use of control rods, moderator, coolants
uses of nuclear reactors

(c) Nuclear fission:
fusion of light nuclei form to a heavier nucleus: release of energy
reference to fusion in the sun and the hydrogen bomb

4. Living in an Atomic Age (½ week)

(a) The Impact of Nuclear Physics on everyday life:
radioactive materials used as tracers
radioactive materials used in industry
radioactive materials used in medicine: cobalt bomb radiation therapy

(b) Radiation Hazards:
sources of radiation – radioactive wastes; atomic bomb fallout
effects of radiation on humans
radiation protection; brief reference to shielding materials; remote control handling